

BRIDGING THEORY AND PRACTICE: TVET ACTIVITIES FOSTERING KNOWLEDGE APPLICATION IN STEM

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Abstract: The purpose of this book is to provide educators, students, and parents with guidance on the role of Technical and Vocational Education (TVET) in STEM (Science, Technology, Engineering, And Mathematics) education. Specifically, it addresses how to implement current trends in the classroom, particularly when it comes to TVET-STEM activities in Malaysia. This paper aims to give an overview of TVET's role in STEM education, which is to help people discover and develop their educational potential, career, and psychology in order to reach an optimal level of social motivation and personal development. This is in accordance with the needs of 21st-century education and the realization that many educators, parents, and students are still unsure about this role. The progress of STEM education is greatly aided by TVET. Generally speaking, TVET allows students to apply STEM concepts in real-world contexts through experiential learning. This aids in their integration of STEM concepts with practical, industrial uses. Furthermore, TVET offers a different kind of education for people who cannot or will not pursue postsecondary education in STEM fields. This enables people to get practical skills in a range of STEM fields, including as mechanical, electrical, and information technology, without needing to pursue an extensive academic degree.

Keywords: TVET, STEM, Context, technology

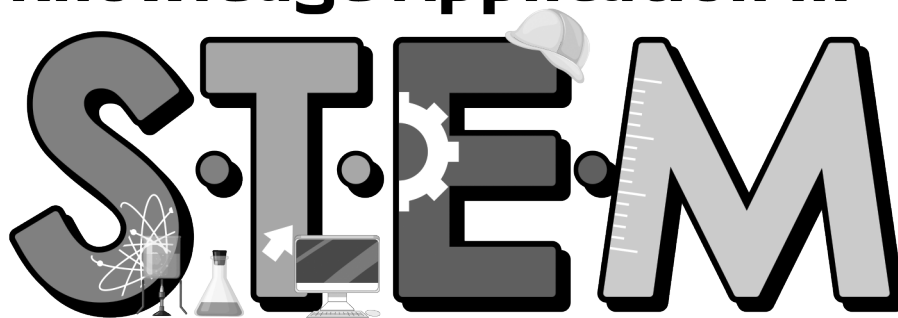
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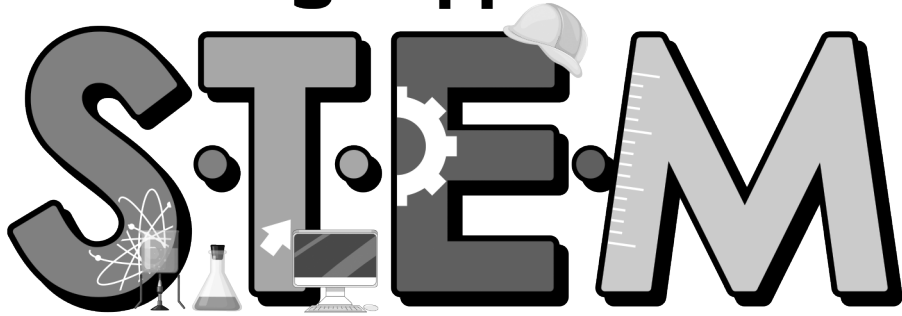


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Preface

This book was written as a guide for educators, students, and parents on the role of Technical and Vocational Education (TVET) in Science, Technology, Engineering, and Mathematics (STEM) Education, particularly in carrying out classroom activities that follow current trends, especially in activities based on TVET-STEM in Malaysia. In accordance with the needs of the 21st century education and the realisation that there are still many educators, parents, and students who are uncertain about the role of TVET in STEM education, which is the process of assisting people in discovering and developing their educational potential, career, and psychology in order to reach an optimal level of personal development and social motivation, the purpose of this book is to provide an overview of the role of TVET in STEM education.

TVET plays a significant role in the advancement of STEM education. In general, through experiential learning, TVET enables students to implement STEM concepts in real-world settings. This helps them integrate STEM theories with industrial and everyday applications. In addition, TVET provides an educational alternative for those who are unable or unwilling to pursue STEM-related higher education. This affords individuals the opportunity to acquire practical skills in various STEM disciplines, including information technology, engineering, and mechanical engineering, without having to pursue a lengthy formal education.

In addition, numerous TVET programmes work closely with the local industry to integrate training that meets the requirements of the industry. This enables TVET students to participate in practical initiatives and internships, as well as gain direct insight from STEM professionals. This collaboration helps bridge the divide



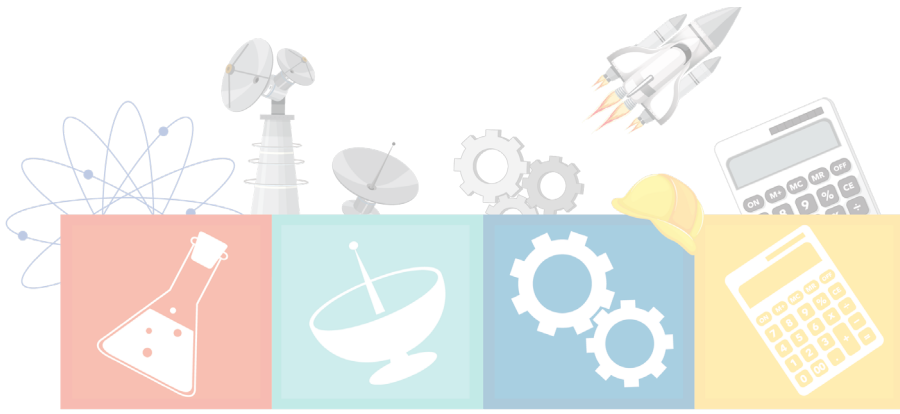
Introduction

The author would like to express our inexhaustible gratitude to Allah Taala because, with His abundance and favour, we been able to prepare and publish this book for readers, particularly educators and students who have the potential to become teachers. As a result of the author's initiative to gathered information and share with others in order to assist them in gaining a deeper understanding of how to manage diverse teaching and learning activities in order to confront challenges in student development and difficulties in regulating behaviour throughout the teaching and learning process.

This book is divided into chapters to assist the reader in comprehending the function of TVET in STEM education. TVET plays a vital role in STEM education for a number of essential reasons. TVET provides a hands-on approach to STEM education in which students have the opportunity to develop practical skills applicable to the STEM industry. Not only do they comprehend the theoretical concepts, but they can also apply them in practise. This facilitates the connection between theory and practise, allowing for a deeper understanding and more effective application in daily work.

Moreover, TVET expands access to STEM education. Not all students are interested in or capable of pursuing STEM-related higher education, but TVET provides a more practical alternative. This affords individuals from diverse contexts the opportunity to acquire STEM skills without pursuing a lengthy formal education. Close collaboration between TVET and industry contributes to the production of STEM-ready graduates. So that students can



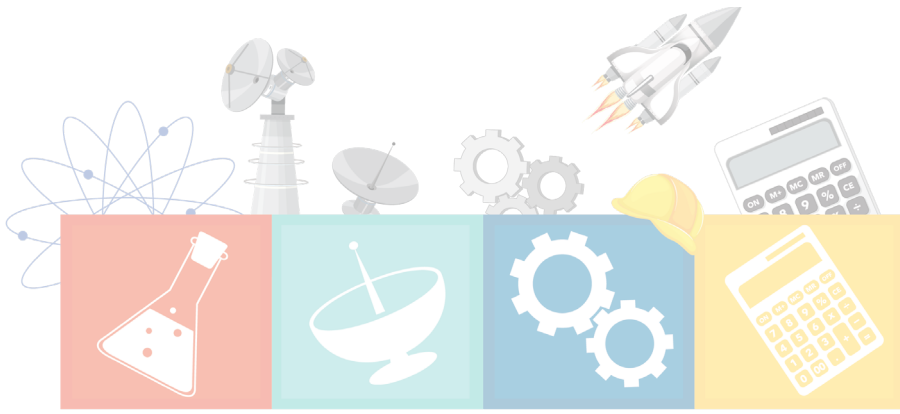


Introduction to TVET in STEM Education

The practice of technical and vocational education and training (TVET) is closely linked to the transformations in the economy and society, as well as the introduction of novel work characteristics. The growth of Industry 4.0 has prompted an increased emphasis on interdisciplinarity in teaching, knowledge creation, and educational techniques (Chou et al., 2018). TVET comprises a comprehensive range of educational pathways, including formal, non-formal, and informal learning. Its primary objective is to provide young individuals with the essential knowledge and skills required to thrive in the professional sphere. According to the definition provided by the United Nations Educational, Scientific, and Cultural Organization (UNESCO), TVET encompasses the study of technology and its associated sciences, alongside the acquisition of practical skills, attitudes, and knowledge that are relevant to employment across diverse economic sectors and social contexts (Rasul et al., 2015).

TVET provides young individuals with the opportunity to enhance their education in a range of institutional and occupational contexts, progressing from foundational to more advanced levels. Furthermore, it is imperative for Malaysia to





TVET Issues in STEM Education

TVET is a type of education that focuses on giving students the knowledge and practical skills they need to succeed in the workplace. The development of students' STEM skills depends heavily on TVET programs. To provide effective STEM education, TVET colleges must overcome a number of obstacles. The nation has created and used a range of ideas and techniques to integrate STEM education into TVET. Even though there are still challenges and problems, the country gains more advantages than disadvantages from the adoption of STEM education in TVET. This is because the policies adopted by each of these countries are intended to progress their individual economic sectors, specifically the generation of more students with the potential to become qualified workers to meet the industry's expanding demand.

Education in the nation is indirectly improving at the same time as the progress brought on by the use of new technology. In recent years, officials in several countries around the world have prioritized STEM education. The Malaysian Education Development Plan 2013-2025 stipulates that students in secondary school must have a high level of critical thinking

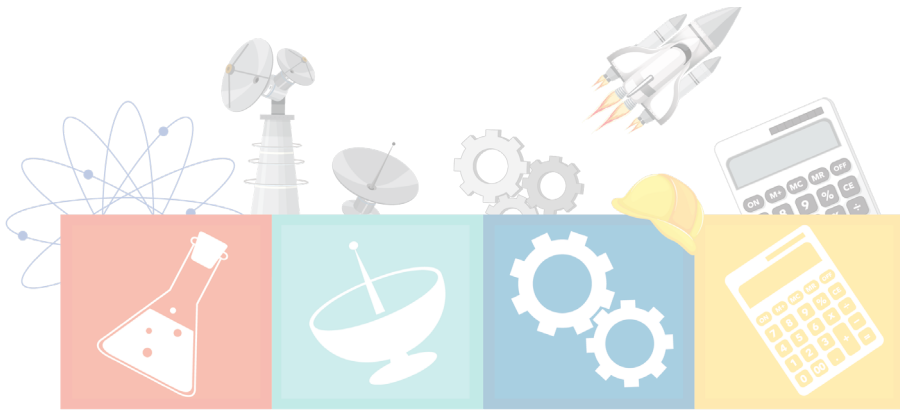


The Transformational Requirements of TVET Graduates Possessing STEM Skills

The initial TVET programme consisted of a practical component that accounted for 70% of the curriculum, accompanied by a theoretical component making up the remaining 30%. To enhance experiential learning, a widely employed strategy involves the utilisation of work demonstrations. Within the realm of theoretical education, the educator will impart knowledge through the distribution of written resources, such as notes and documents, containing pertinent information and data. When embarking on a transition to a STEM-TVET integration programme, it is important to note that the fundamental components of the TVET learning process remain unaltered.

Nevertheless, the programme integrates supplementary generic STEM skills into hands-on exercises. In the context of theoretical education, a crucial element of applied STEM disciplines involves the ability to proficiently tackle and find solutions to intricate

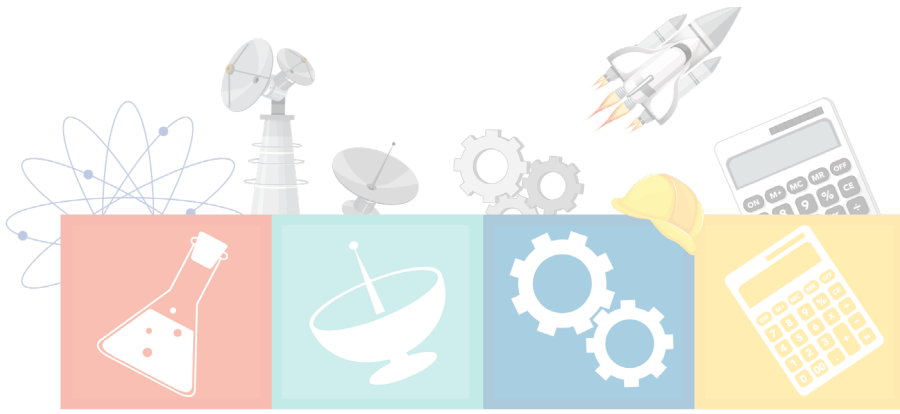




The Implementation of STEM Per National Standards in the Field of TVET

Today, the government continuously formulates, promotes and coordinates TVET strategies and programs that are in line with the needs of the Malaysian economy, technology and society. TVET has been chosen as a key component to achieve the country's goal of being a high-income country by the 21st century. This is to ensure that there is a constant, adequate and timely supply of multi-skilled workers that will be able to meet the development of the country. A major emphasis on improving the quality of education and skills-based training, raising awareness and increasing the perception of TVET and strengthening collaboration with industry for better recognition are among the next steps that need to be taken.

However, these transformations and efforts are not enough to discuss how TVET can be modified into a better system, especially if the country has to compete internationally in



Implementation of TVET- STEM Activity

STEM-focused TVET programmes play an essential role in enhancing secondary school students' knowledge in various ways. The following approaches demonstrate how TVET-STEM activities contribute to the development of knowledge among secondary school students:

Project-Based Learning:

Most TVET-STEM programmes emphasise project-based and practical learning. Students engage in initiatives that apply science, technology, engineering, and mathematics concepts to real-world scenarios. This facilitates a deeper understanding of concepts and the development of practical abilities.

Contextual Learning:

Frequently, TVET-STEM activities link academic concepts to real-world applications, fostering contextual learning. This helps students see the relevance of what they are learning to ordinary life and the workplace. They can learn, for instance, how mathematical concepts are utilised in the design of technological products.



BIBLIOGRAPHY

- Adnan, M. H. M., Ariffin, S. A., Hanafi, H. F., Husain, M. S., & Panessai, I. Y. (2020). A Social Media Analytics Framework to Increase Prospective Students' Interests in STEM and TVET Educationx. *Asian Journal of University Education*, 16(4), 82-90. <https://doi.org/10.24191/ajue.v16i4.11945>
- Akgunduz, D., & Mesutoglu, C. (2021). Science, Technology, Engineering, and Mathematics Education for Industry 4.0 in Technical and Vocational High Schools: Investigation of Teacher Professional Development. *Science Education International*, 32(2), 172-181.
- Baharin, N., Kamarudin, N., & Manaf, U. K. A. (2018). Integrating STEM education approach in enhancing higher order thinking skills. *International Journal of Academic Research in Business and Social Sciences*, 8(7), 810-821.
- Bakar, A.Y.A., & Mahmud, M.I. (2020). The Profiling of Aspiration and Interest towards STEM and TVET Careers among Malaysian School Students. *Journal for the Education of Gifted Young Scientists*, 8(1), 489-500.
- Berisha, F., & Vula, E. (2021). Developing Pre-service Teachers Conceptualization of STEM and STEM Pedagogical Practices. *Frontiers in Education*, 6(May). <https://doi.org/10.3389/educ.2021.585075>
- Campbell, C., & Rolls, J. (2017). Retracted Article: Fostering student persistence on TVET pathways through mutual adaptation: a case study of Qatar.



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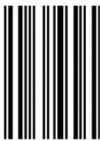
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